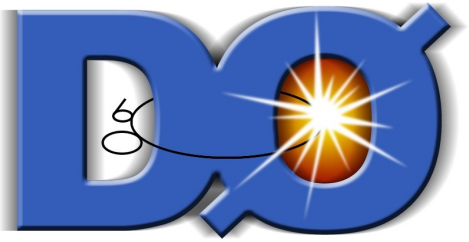
Search for Tau Sneutrino particles in the e+μ final states at DØ

Xuebing Bu

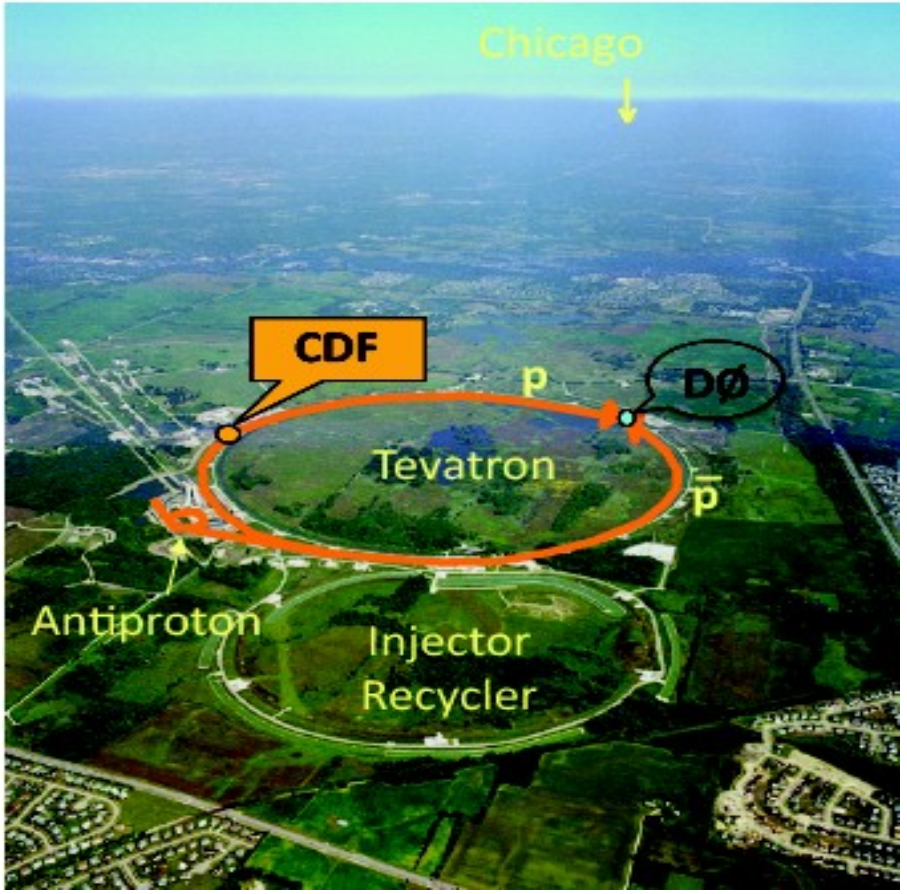
University of Science and Technology of China

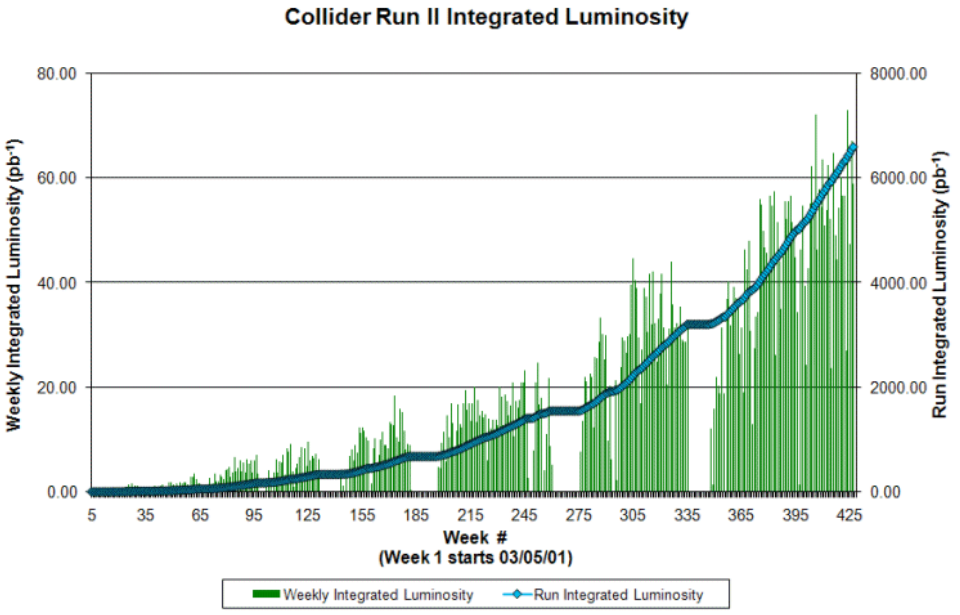
On behalf of the DØ collaboration



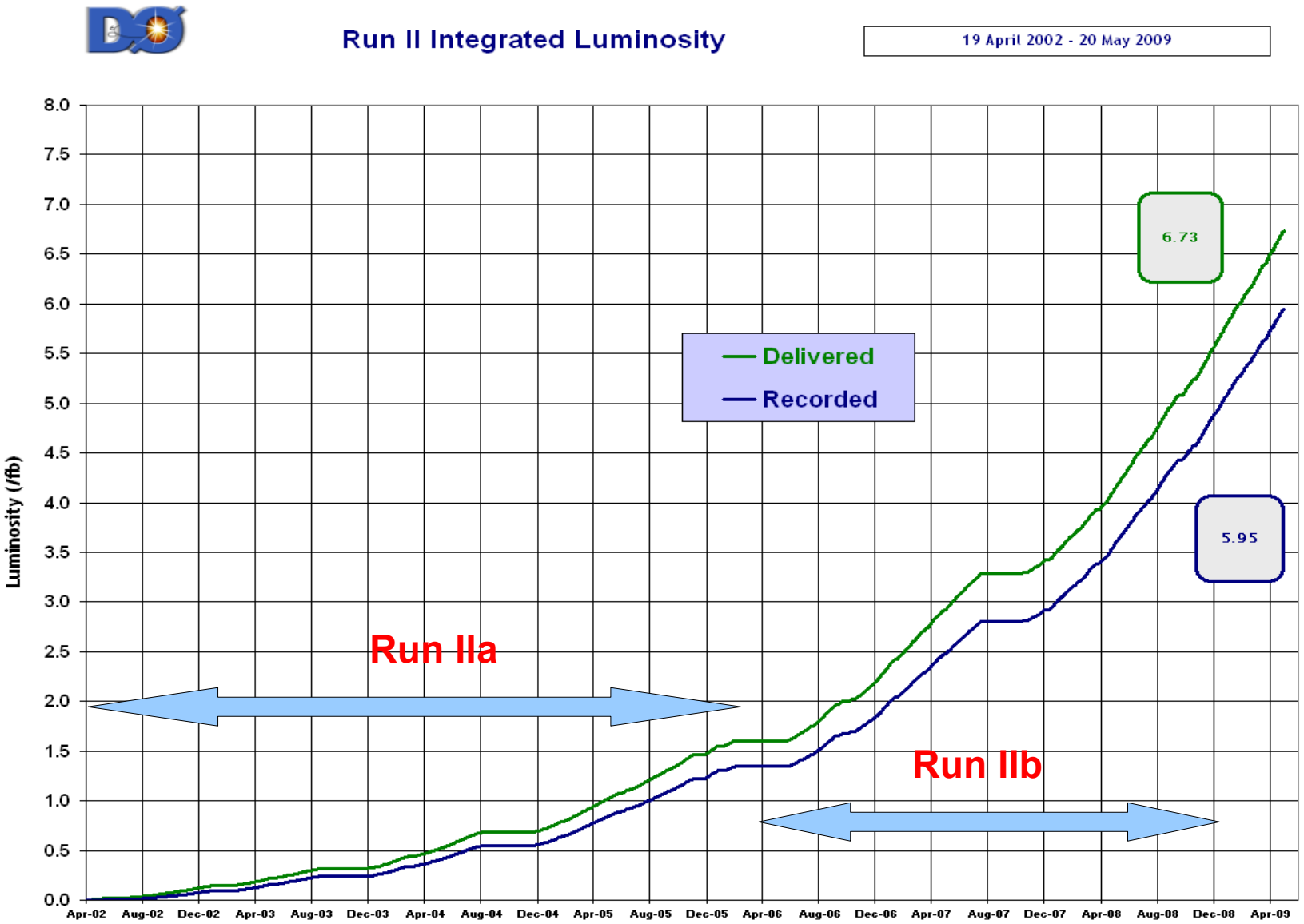
Tevatron

- World's largest proton-antiproton collider
- Excellent performance (peak lumi. ~ 3.50E+32)

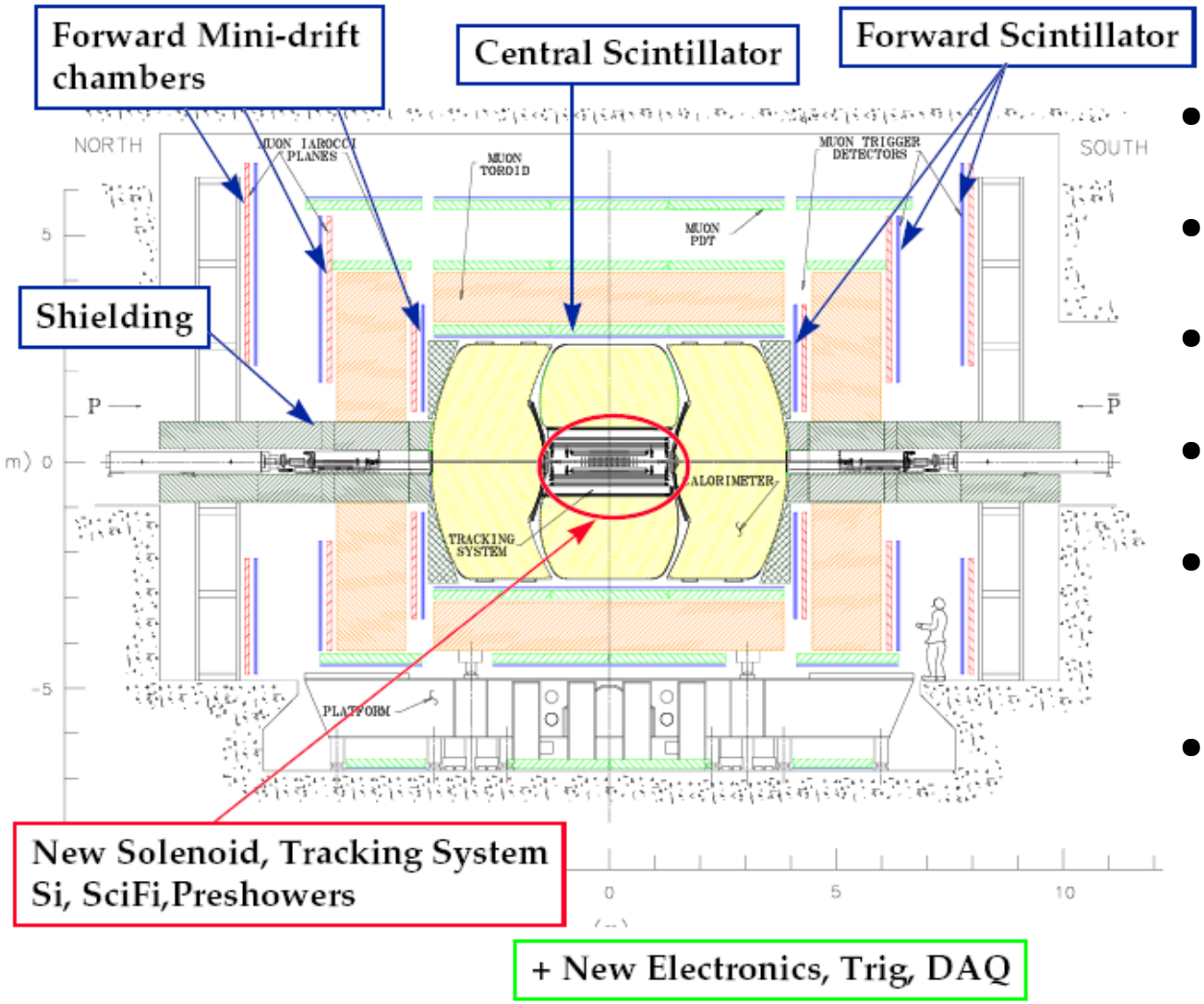




~6 fb^{-1} data on tape



DØ detector



- Electrons: $|\eta|<3.0$
- Muons: $|\eta|<2.0$
- Silicon tracking: $|\eta|<3.0$
- Calorimetry: $|\eta|<4.2$
- High data taking efficiency ~ 90%
- Well-understood detectors and mature analysis tools

Phenomenology Motivation

SUSY new parity

$$R=(-1)^{2S+L+3B}$$

- **spin S**
- **lepton number L**
- **baryon number B**

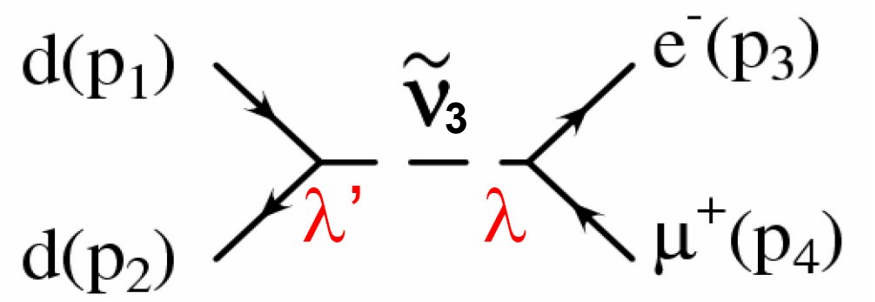
partially R-parity violation (RPV) *i.e. non-simultaneous* L and B violation in general super-potential

$$W_{\not R_p} = \frac{1}{2}\varepsilon_{ab}\lambda_{ijk}\hat{L}_i^a\hat{L}_j^b\hat{E}_k + \varepsilon_{ab}\lambda_{ijk}'\hat{L}_i^a\hat{Q}_j^b\hat{D}_k + \frac{1}{2}\varepsilon_{\alpha\beta\gamma}\lambda_{ijk}''\hat{U}_i^\alpha\hat{D}_j^\beta\hat{D}_k^\gamma + \varepsilon_{ab}\delta_i\hat{L}_i^a\hat{H}_2^b$$

Phenomenology:

+ *neutrino-oscillation* + *stable Proton*
+ *scalar sneutrino resonance production and LFV decay*

The Feynmann digram of sneutrino eμ resonance production at Tevatron:



The cross section of the signal only depends on the third generation sneutrino mass and the LQD and LLE couplings:

$$\hat{\sigma}_{e\mu} \propto (\lambda'_{311})^2 \times (\lambda_{312})^2 \cdot \frac{1}{|\hat{s} - M^2 + i\Gamma M|^2}$$

where the total width of the sneutrino can be written as:

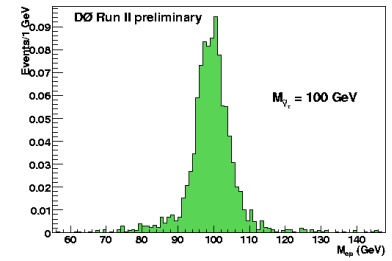
$$\Gamma = [3 \cdot (\lambda'_{311})^2 + 2 \cdot \lambda^2_{312}] \cdot \frac{M}{16\pi}$$

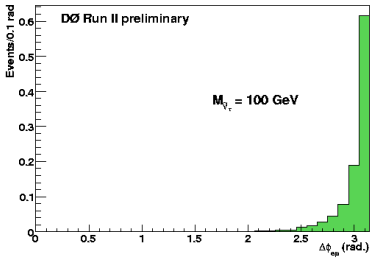
The parameter constraints from LEP are:

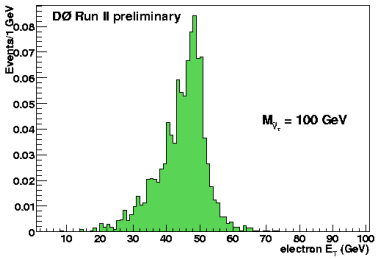
$$\lambda'_{311} \leq 0.12, \quad \lambda_{312} \leq 0.07, \quad for\ M \equiv M_{\tilde{\nu}_\tau} \geq 100\ GeV$$

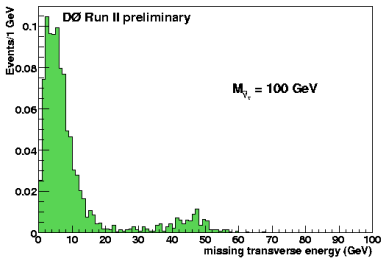
Signal characteristics

- M =100 GeV









- High pT leptons (~0.5*Mass)
- Electron and muon are almost back-to-back
- Clear mass peak
- No missing transverse energy

Event selection

- Electrons
  - p_T>30 GeV
  - $|\eta| < 1.1$
  - Matched with a track
  - Isolated in the calorimeter
  - EM shower
- Muons
  - p_T>25 GeV
  - $|\eta| < 2.0$
  - Matched with a track
  - Isolated in both calorimeter and tracker

Major backgrounds

- Physical background:
  - Z/γ*->ττ
  - WW,WZ,ZZ
  - ttbar
- Instrumental background:
  - W+jet/γ
  - Z/γ*->ee,μμ
  - multijet

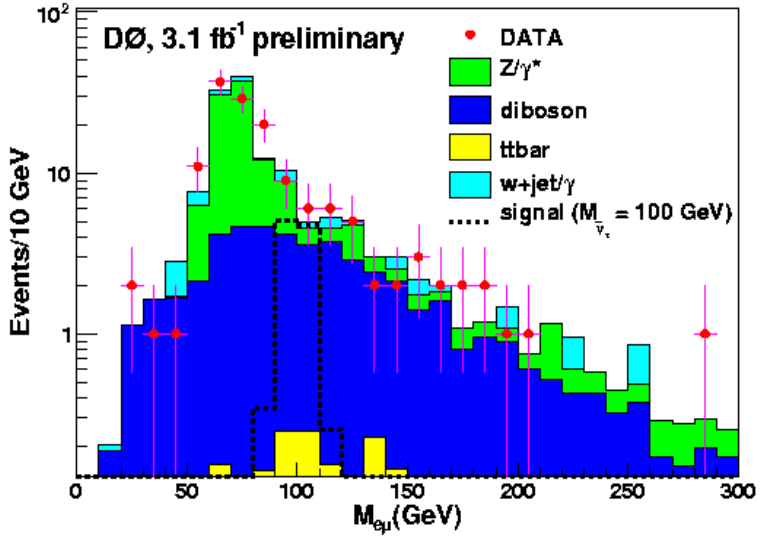
Event selection cont...

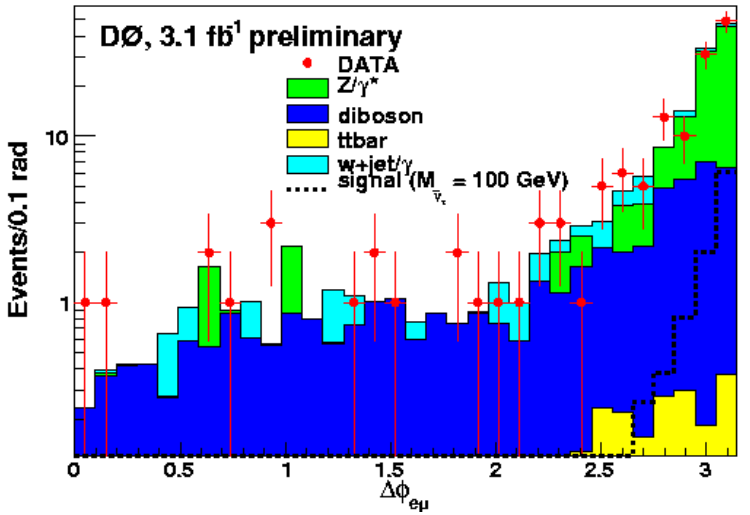
- The two leptons are away from each other with dR>0.2 and required from the same primary vertex;
- To reduce the ttbar contamination, veto the events with at least one pT>25GeV jet;
- To reduce the WW and ttbar contamination, veto the events with missing transverse energy > 20GeV that is not aligned or anti-aligned in azimuth with the muon.

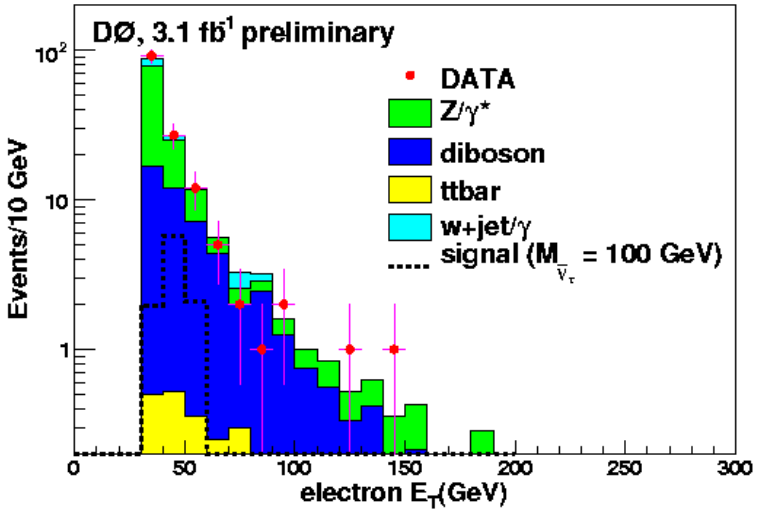
of events after selection

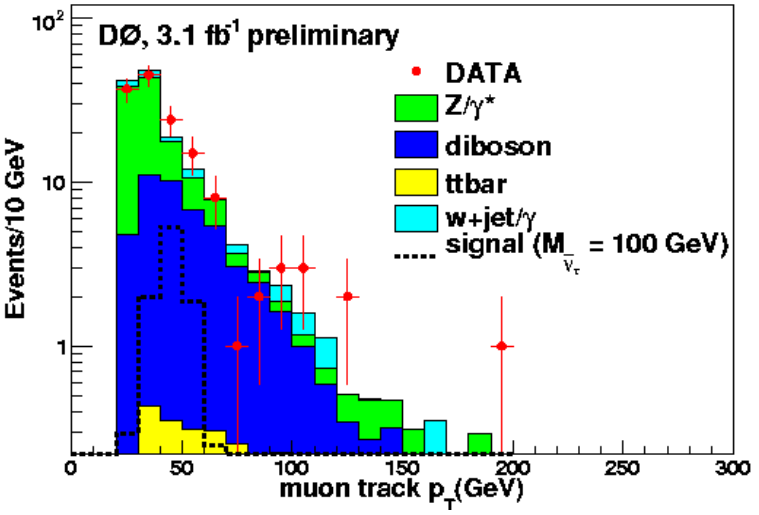
Process	# of events
Z/γ*	83 ± 3
diboson	46 ± 2
W+jet/γ	13 ± 2
ttbar	3 ± 0
Total background	145 ± 4
data	143

Final events distributions

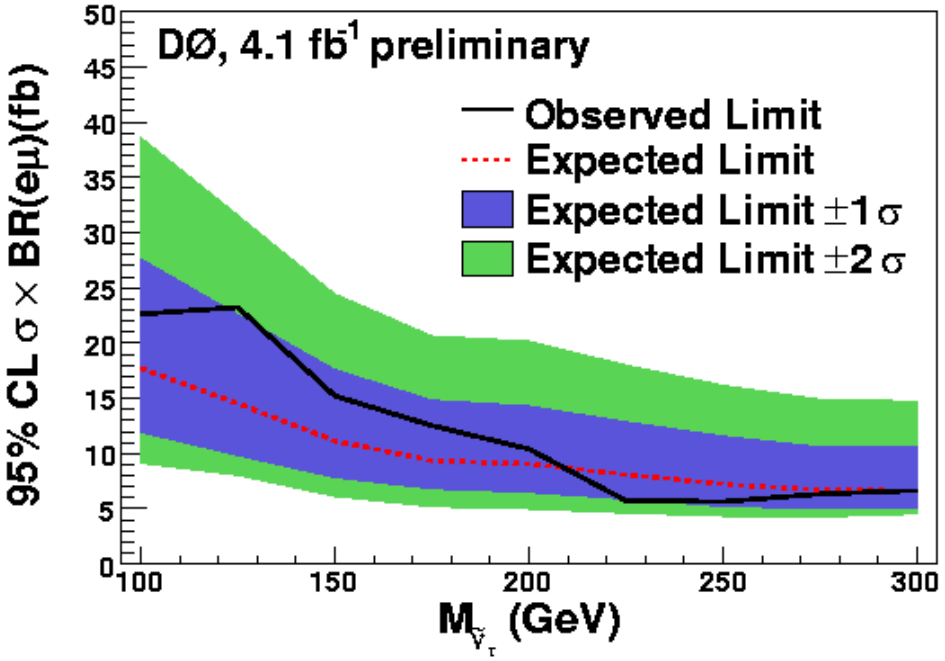


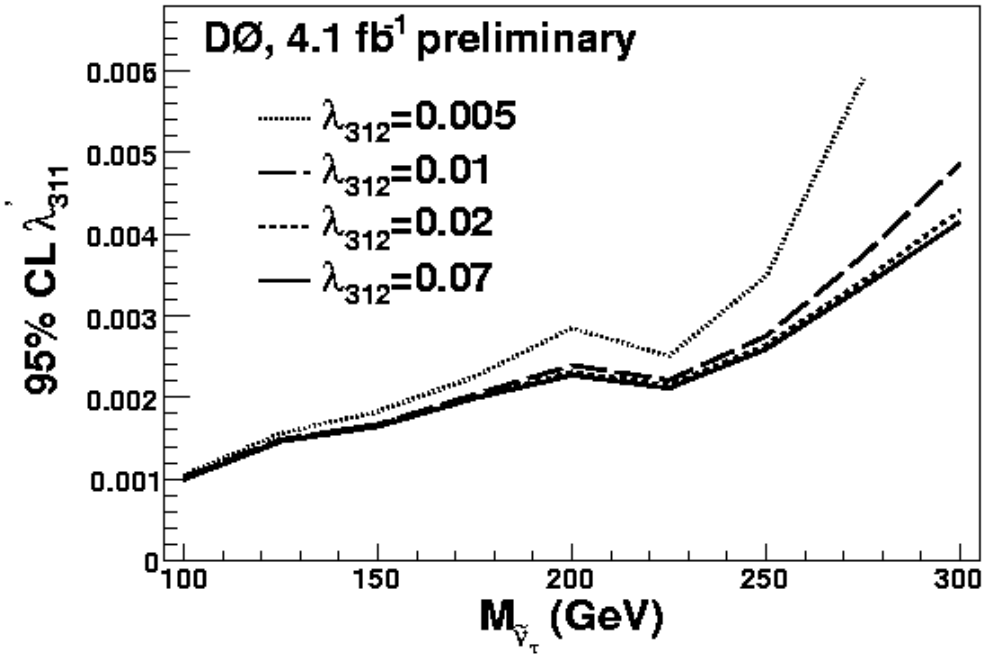






95% C.L. limits





(1) A factor of 2 improvement by comparison with the 1 fb^{-1} DØ publication results (Phys. Rev. Lett. 100, 241803 (2008)).

(2) The limits are significantly improved by comparison with LEP results (0.07x0.12 at M=100GeV).

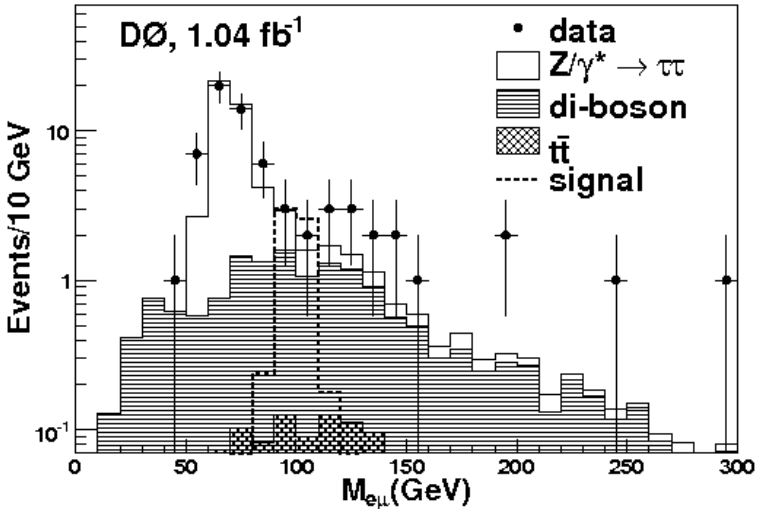
Summary

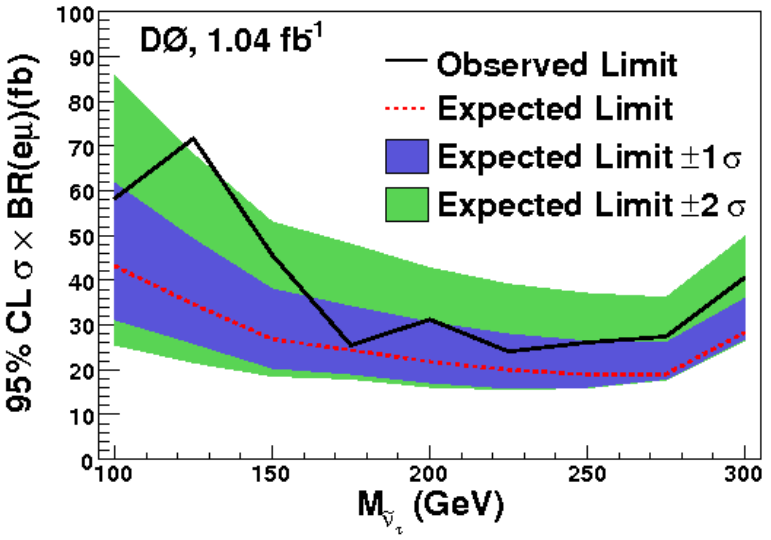
- We presented a search for R-parity violating (RPV) Sneutrino via the e+μ final states in 4.1 fb^{-1} of DØ Run II data.
- We set 95% C.L. limits on the production cross section times branching ratio and RPV couplings for different Sneutrino masses.
- For the near future, we will keep tuning and add more available data.

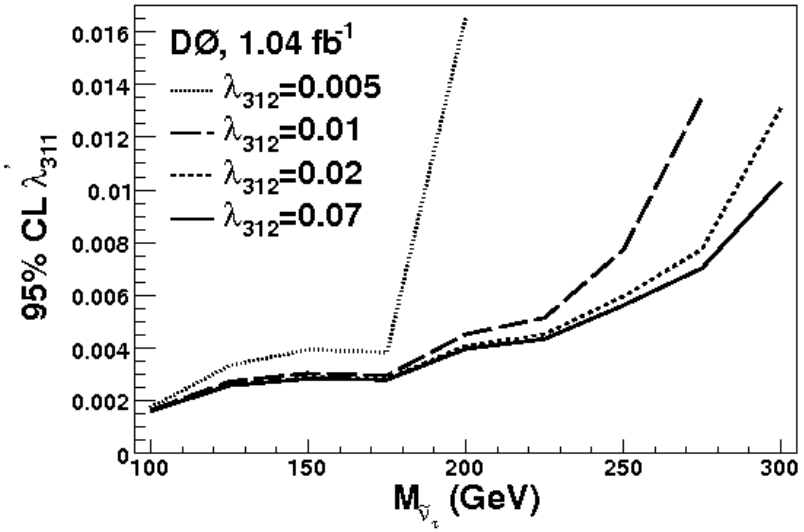
back-up

1 fb-1 published Run IIa results

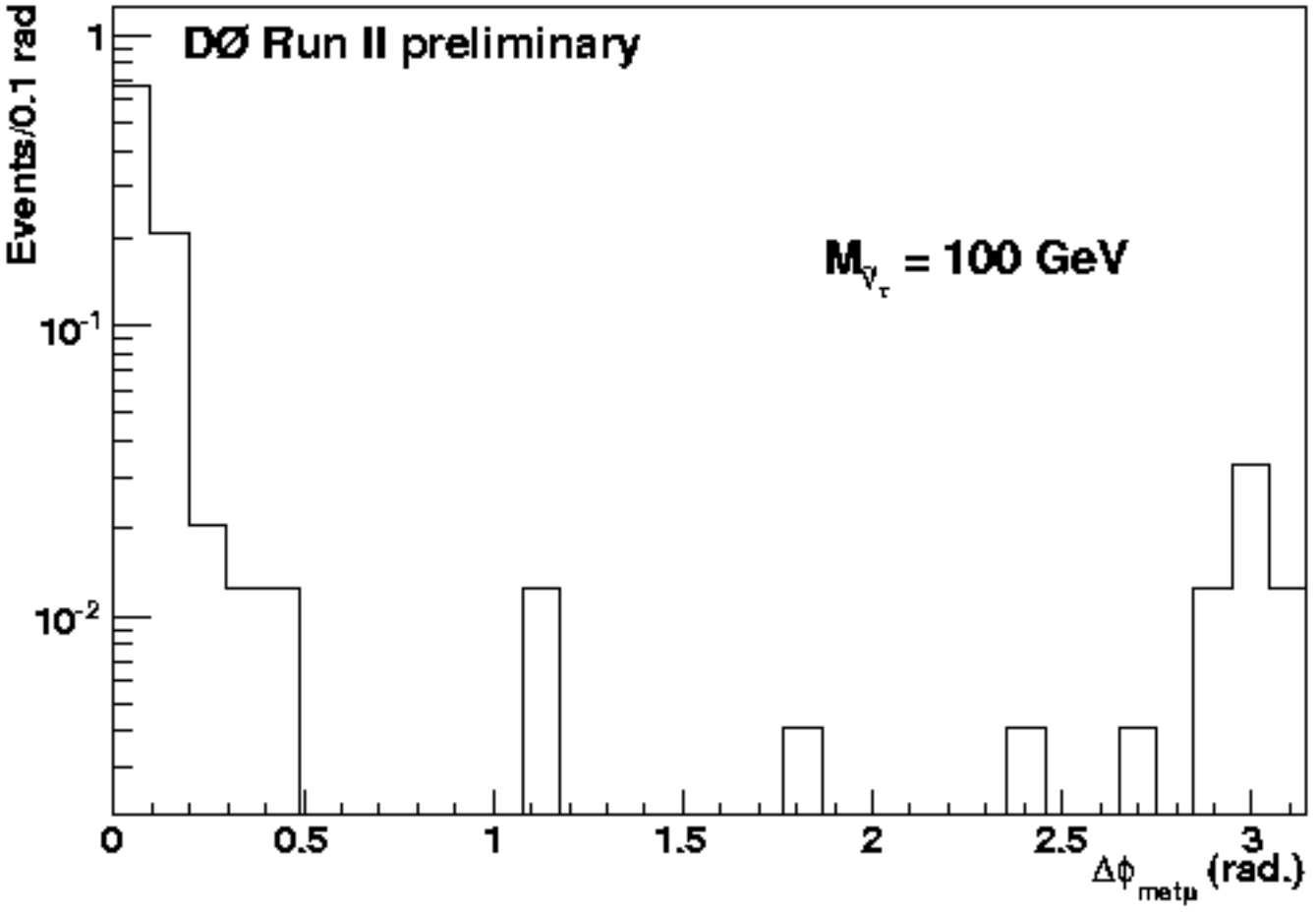
- Phys. Rev. Lett. 100, 241803 (2008)







dΦ (met, μ)


DØ Run II preliminary
M_{ν_τ} = 100 GeV
Events/0.1 rad
1
10^{-1}
10^{-2}
0
0.5
1
1.5
2
2.5
3
$\Delta\phi_{met\mu}$ (rad.)